Space Weather Technical Forecast

Issued on Saturday, 29 October 2022 at 01:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor geomagnetic storms throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity over the past 24 hours has been Low, with several very low level C-class flares. There are six numbered sunspot regions on the solar disc, with the most active, and also most development seen in AR3135 Dso/Beta in the northeast. This currently has a simple bipolar structure, however further growth is likely. The largest region remains AR3131 Cho/Beta also in the northeast, whilst AR3130 Dai/Beta in the southwest and AR3133 Dai/Beta in the northeast have seen little development. The other two regions are small and simple. No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1 has been indicative of a fast wind arrival, although it is currently uncertain if this is due to ongoing effects of CH36/+ or early arrival of CH37/+, or some combination of the two. Initially slightly elevated winds with speeds of around 420-460 km/s eased to background before erratically rising from 28/1010 UTC to peak at 28/1545 UTC at around 550 km/s. Elevated winds then generally persisted. The density was mainly at or just above average values, but with a peak of 17 ppcc. The total IMF strength Bt, was initially weak, before rising to 11 nT at 28/1404 UTC, and then persisted mainly moderate at 7-11 nT. The north-south component, Bz, varied weakly at first, but became moderate at -10 nT by 28/1419 UTC. This then erratically rotated to +11 nT by 28/2155 UTC and then back to negative values. The phi angle was variable at first, but became predominantly positive (away from the Sun) from 28/1647 UTC. Geomagnetic activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2MeV) at GOES-16 was at background levels. The associated 24-hour integrated fluence was below the Active (1e8 integrated pfu) threshold, with 1.65e6 integrated pfu observed at 29/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low, but with a daily slight chance of isolated M-flares, most likely from developing region AR3135 in the northeast.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Earth is currently in a fast wind enhancement, likely from a combination of CH36/+ and CH37/+ fast winds. Elevated winds are likely for much of the period, with further occasional enhancements possible. These most likely either day 1 (29th) or perhaps day 3 (31st) due to the arrival of fast winds from CH38/+. Quiet to Unsettled geomagnetic activity expected with Active intervals. There is a chance of G1/Minor storms, most likely early day 1 (29th), but possible throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) observed by GOES-16 is expected to be at background levels. High energy electron flux (greater than 2MeV) observed by GOES-16 is forecast to be at Background to Moderate levels days 1-3 (29th to 31st), likely only rising day 4 (1st) as solar wind pressure decreases. The associated 24

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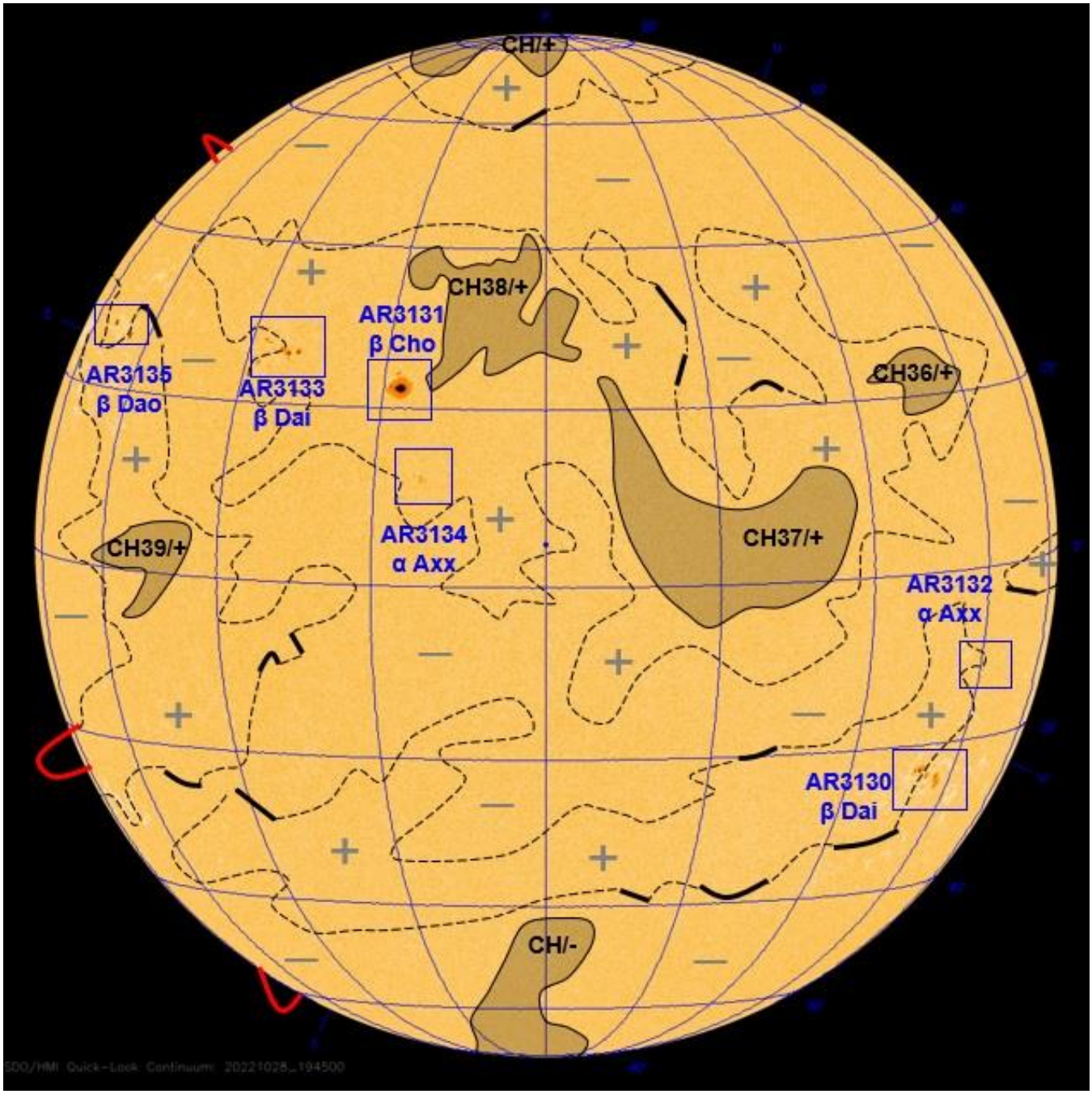
hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold until the end of day 4 with a chance of then rising above.

Figure 1. Solar Analysis Valid 29/2000 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs.

There are a series of coronal holes on the Earth-facing disc, with Earth now likely within the fast wind of CH36+ and CH37+ combined, with the recent enhancement occurring earlier than persistence indicated. Peak solar winds of around 550-600 km/s at first, have the potential to ease a little later day 1 or day 2 (29th or 30th), before a further transition is likely into the fast wind of CH38/+ day 3 (31st). Overall, however, elevated winds are likely to persist for much of this period, in line with both enlil and 27-day persistence.

Quiet to Unsettled activity expected through, with Active intervals. There is a chance of occasional G1/Minor storms though the period, most likely day 1 (29th), when elevated winds combine with periods of negative Bz.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	60	20	30	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2a: Solar Wind Persistence Model – Elevated winds likely for much of the upcoming period.

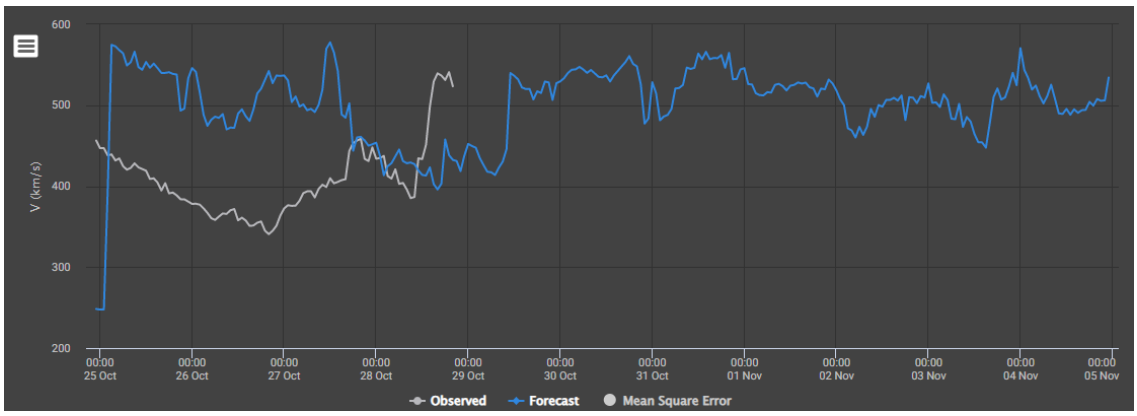

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Figure 2b: SDO aia-211 of last rotation and current Similar CH structure evident.

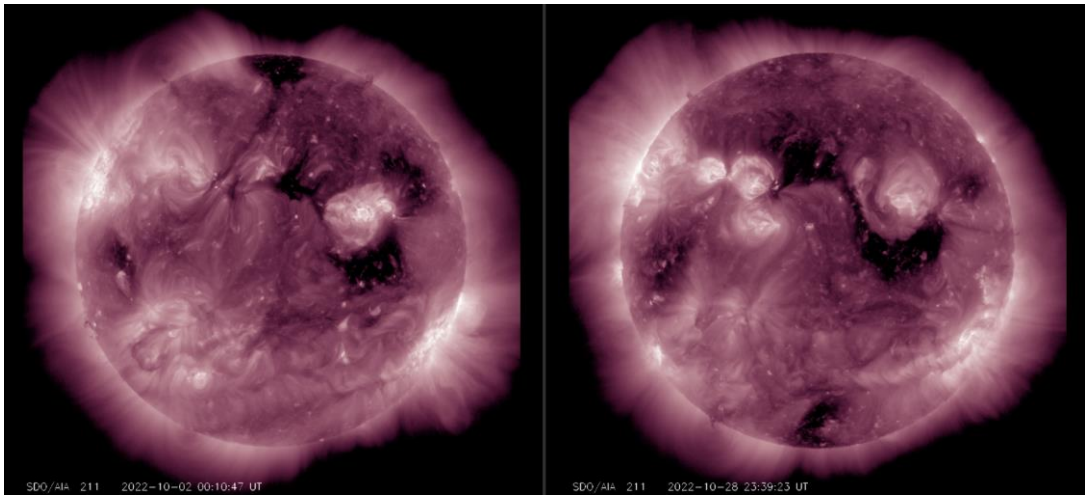
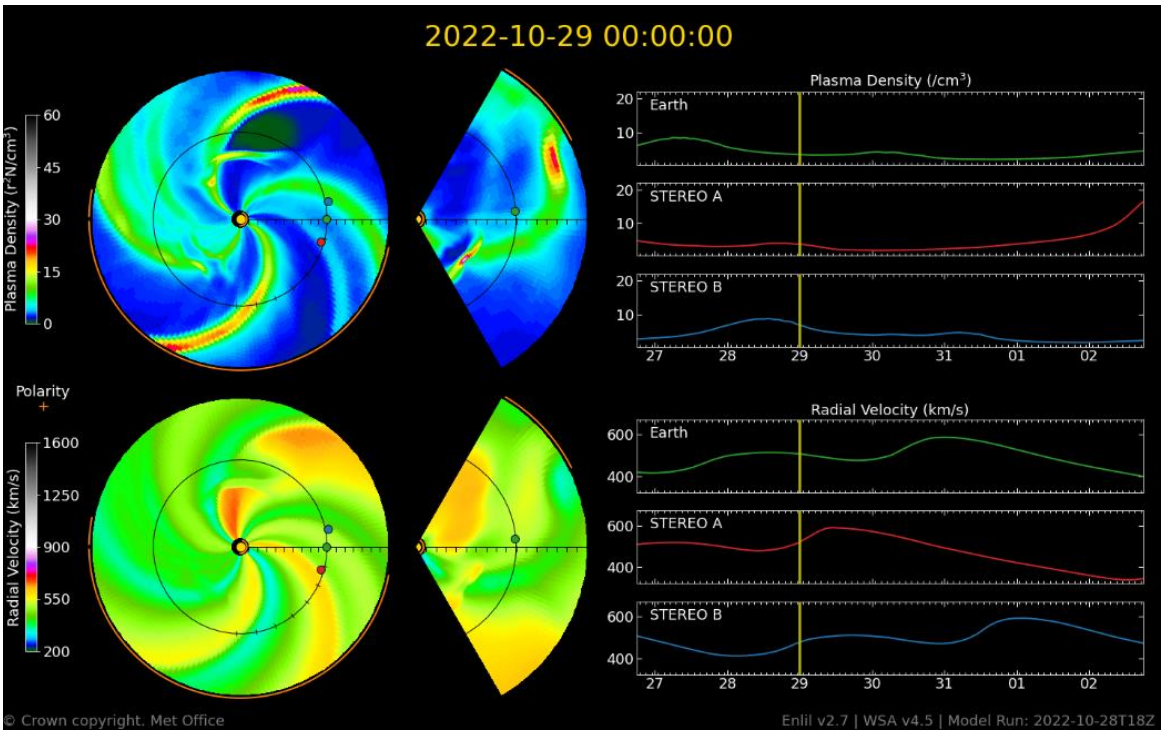


Figure 2c: Enlil forecast winds. Has further enhancement on the 30th or 31st.



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Radio Blackouts - X-Ray Flares:

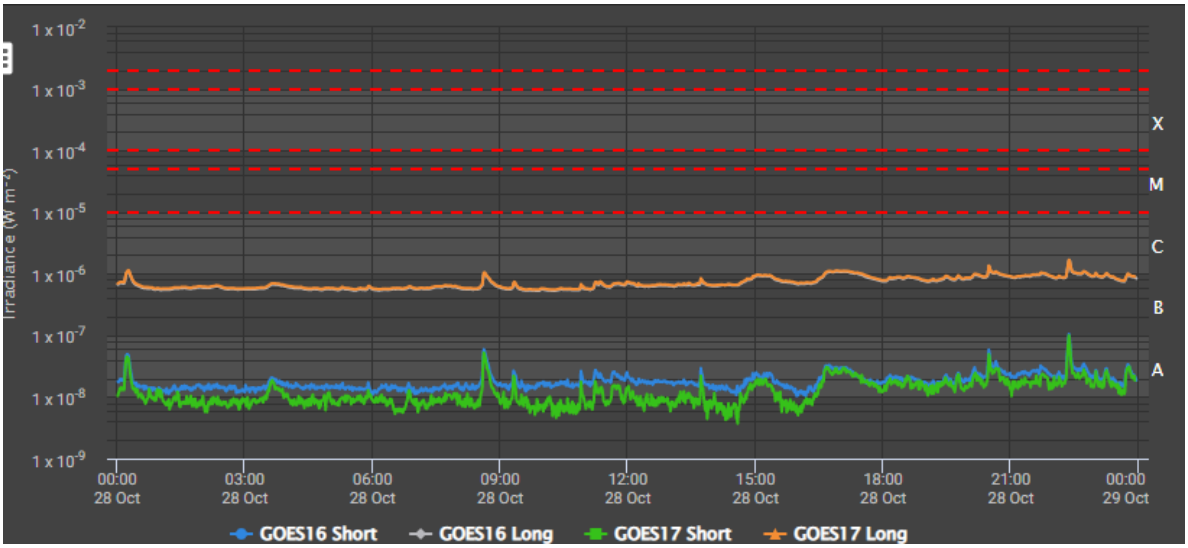
Solar activity is expected to be Low through the period, with a slight chance of rising to Moderate due to isolated M-flares from any of the six sunspots currently on the disc.

The most likely source is newly developed AR3135 Dso/Beta in the northeast. Despite a relatively simple bipolar structure, this has rapidly emerged in the last 24 hours, and further growth is possible. The largest region remains AR3131 Cho/Beta also in the northeast. This currently stable region, is predominately one large positive polarity leader spot, but has a small negative polarity companion to its north. AR3130 Dai/Beta in the southwest and AR3133 Dai/Beta in the northeast have seen little development in the last 24 hours, remaining small regions and reducing their potential for notable flaring. The other two regions are small, simple and decaying.

Further regions are also likely to rotate onto the northeast disc through the period, with STEREO A euvi imagery indicating a broad, bright area of flux that will gradually rotate onto the Earth-side.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/17 X-ray Flux.



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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background and is currently expected to remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO hmi Intensitygram and Magnetogram of northeast disc AR3135, AR3133 and AR3131 from left to right.

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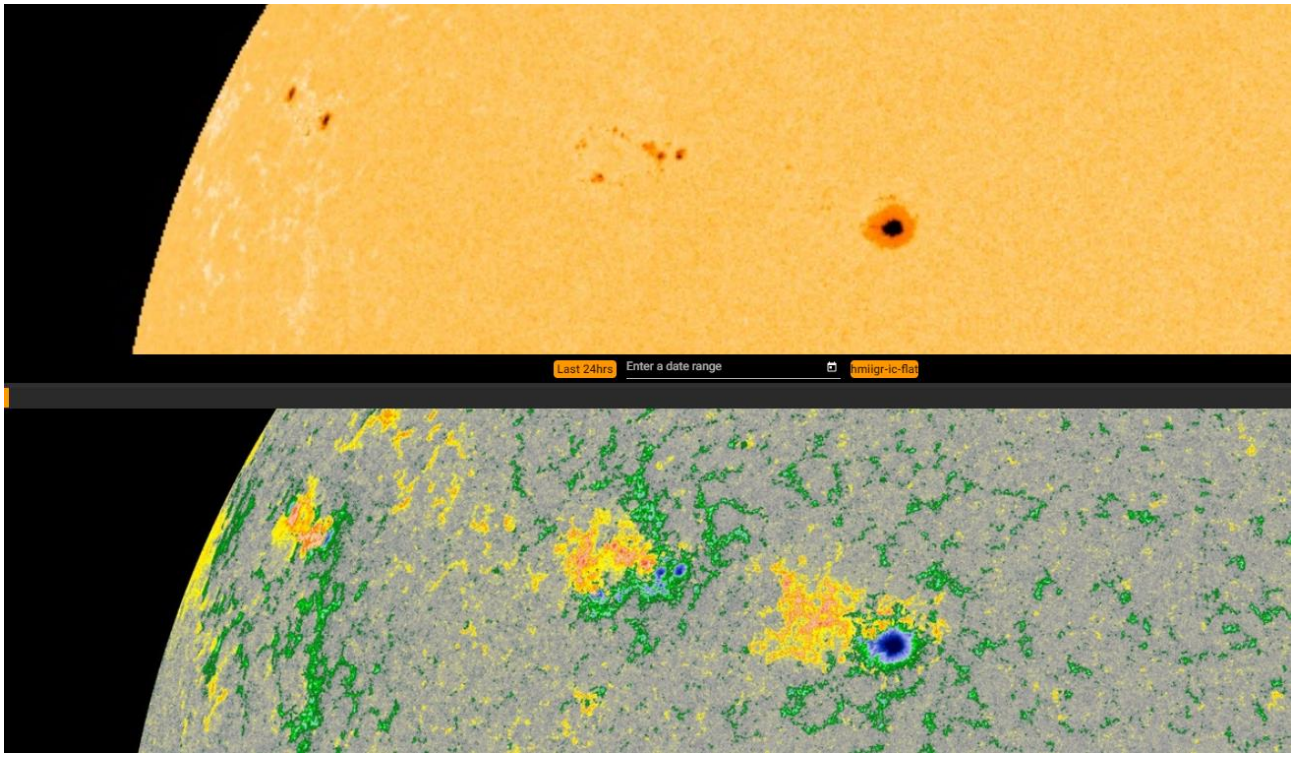

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High Energy Electrons Event (≥ 2MeV):

On days 1-2 (29th and 30th) elevated solar winds are expected to maintain compression on the Van Allen belts, keeping the observed high energy (greater than 2 MeV) electron flux by GOES-16 at GEO largely at Background to Moderate, with only a slight chance of rising to High. This is due to the recent fast wind arrival from CH36/37, and potentially also a further arrival day 3 (31st) from CH38/+. Most likely on day 4 (1st), the Van Allen belts, now populated with electrons from the recent enhancements, are expected to relax back towards GEO. A subsequent increase in flux is then likely, becoming High at diurnal maximum.

The associated 24 hour electron fluence is expected to remain below the Active threshold, but has a chance of rising day by day, most likely rising above the Active threshold by day 4 (1st). This is similar to the previous rotation, and REFM is also currently giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	20	20	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4a: Current GOES-16 >2MeV Electron Flux (top) and Fluence (bottom)

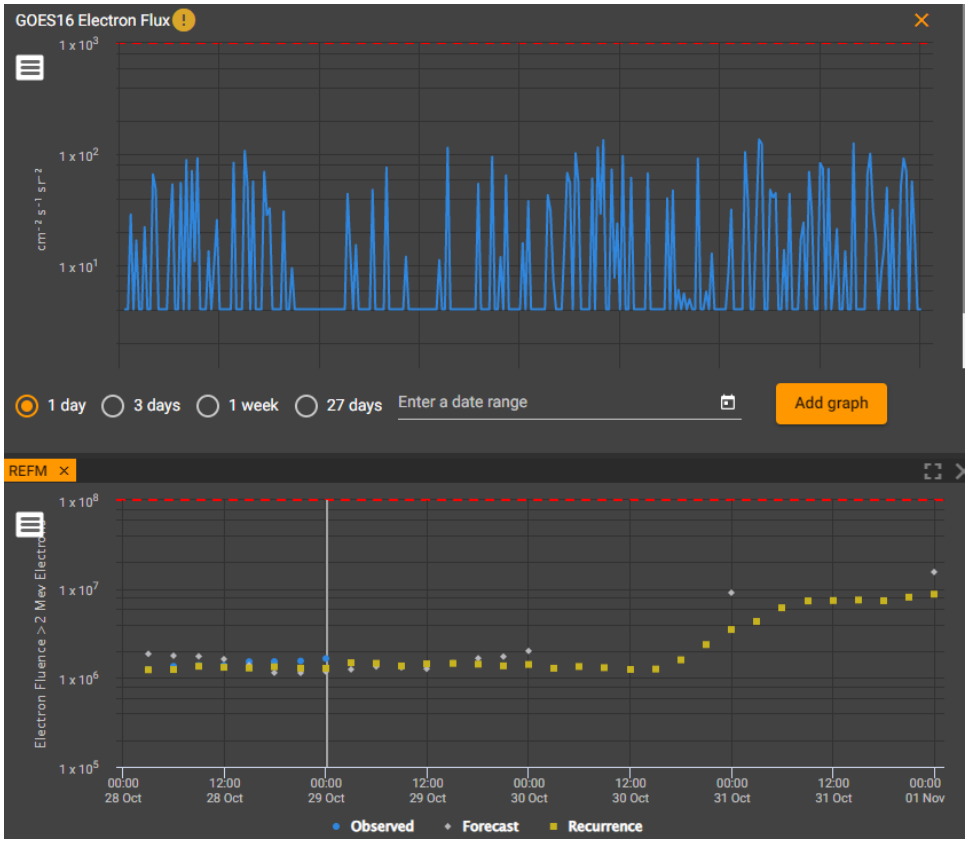

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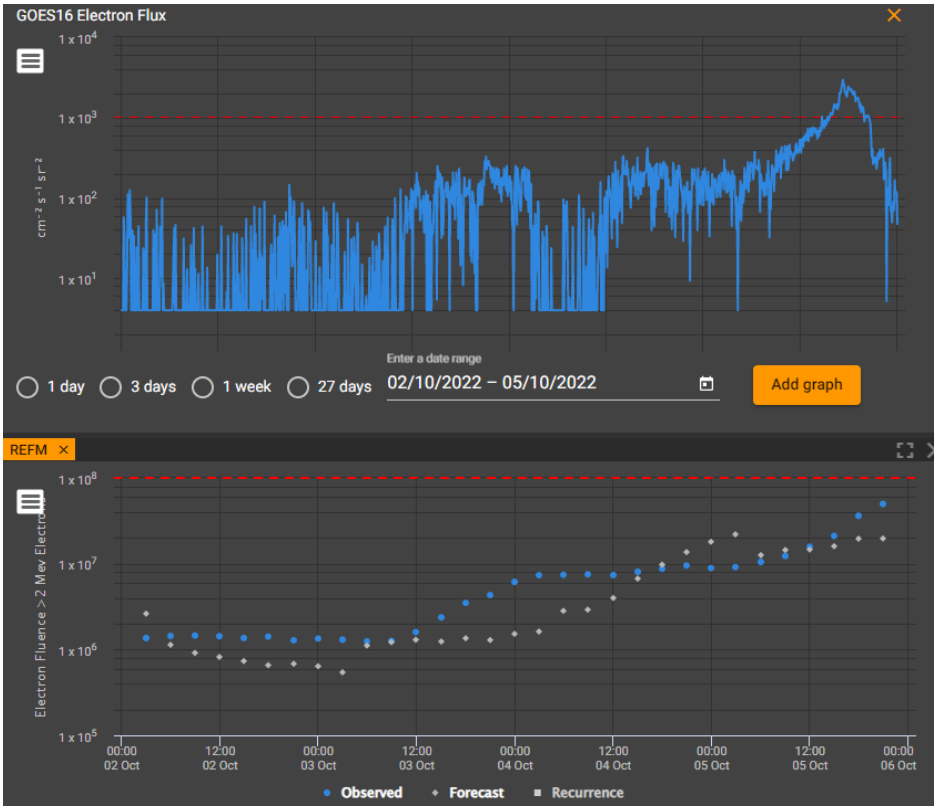
Figure 4b: Observed >2MeV Flux (top) and Fluence (bottom) on last rotation for equivalent days 1-4 (2nd to 5th October) Delayed onset of any high flux clearly evident, although current forecast is for a slightly faster increase on this occasion.



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